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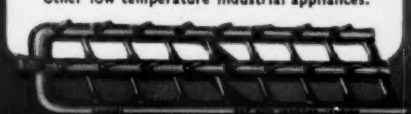

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GAS HEAT *in* INDUSTRY

Vol. XIII September, 1950 No. 156

Pot Life in Gas-fired Galvanizing Settings

By A. HIGGS, M.Inst.Gas E.

THE capital cost involved in installing a galvanizing setting can vary from a few hundred pounds to possibly five thousand pounds. Of this outlay the capital cost of the pot itself can account for between 20 and 30 per cent. A pot failure, apart from the capital cost of the actual pot replacement, involves heavy fixing charges, together with the loss occasioned by a broken production schedule, so that it will readily be realised that pot life has a very important bearing on overall production costs.

Until recent years the factors affecting pot life were not generally known, and galvanizers were frequently confronted with unaccountable pot failures after periods of service of only three to twenty-one days.

The melting point of zinc is 419° C. and the normal operating temperature for the galvanizing process is about 445° C. Zinc reacts with iron at all temperatures above its melting point but the rate of reaction is reasonably slow up to 475° C. From this temperature to 500° C. the rate of attack shows an appreciable increase, whilst above 500° C. it accelerates repidly so that at 520° C. the pot wall thickness is reduced at the rate of approximately (1) 1/1000 of an inch per hour.

Dross, i.e. zinc contaminated with about 6 per cent. of iron forms during the process of dipping steel and also continuously to some degree, by the reaction between the zinc and the pot. This acts as an insulating medium and hence it is important that it does not

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accumulate on active heat transmitting surfaces, otherwise excessive outside pot temperatures may result.

From the preceding observations it will be obvious that overheating of the pot must be avoided. Even local overheating can result in an expensive pot replacement from failure of the pot at the point where this occurs.

In operation, a record of temperature is most desirable as even temporary general overheating of the pot can seriously shorten its life and if not recorded by some means can give a false impression as to the merits of the design.

The pot wall thickness (2) has an important bearing on pot life, and can be decided only after due regard has been paid to shape, capacity and the achieving of the necessary heat transfer.

Induced Draught Settings

After consideration of the foregoing factors, plus the important question of capital outlay; running and maintenance costs; and simplicity of control, the following method of firing was evolved in the North Eastern Area.

Low pressure burners, i.e. burners employing natural draught injectors are fitted at close centres under the refractory-lined top plates of the setting. These are fitted with fishtail burner nozzles to provide a wide flame front and the design is original in that the flames are produced down-hill parallel with the pot sides. This is accomplished by maintaining the whole setting under a slight negative pressure by means of the "pull" created by an eductor. The use of an eductor is favoured in preference to a hot gas exhaust fan as its use simplifies control. The necessary secondary air is induced in controlled proportion in relation to the gaseous fuel input by the use of a North American valve through which the gas supply to the burners, and the air supply to the eductor, are both supplied. Thus control is achieved from a single point. This design avoids high temperature in the vicinity of the burners, since the flames produced are lambent in character, and the insulating refractory which has been used almost exclusively in these settings is recessed in the combustion region to

PERFORMANCE DATA ON INDUCED DRAUGHT GALVANIZING SETTINGS.

Dimensions of Pot and Capacity	*Process*	*Operating Temp.*	*Weekly Throughput*	*Weekly Gas Consumption c. ft.*	*No. of Working hrs./week*	*Pot Life under Induced Draught*	*Pot Life Prior to Induced Draught*
4 ft. 6 in. × 2 ft. 6 in. × 1 ft. 3 in. deep 3 tons	Continuous wire galvanizing	450° C.	300 cwt. of 17 g. wire	30,500 (500 C.V.)	144 hr.	3 years	Gas-fired setting. Air/blast burners 3-6 months
12 ft. × 1 ft. × 1 ft. 6 in. deep 2½ tons	Galvanizing window-frame components	445° C.	111½ cwt.	68,525 (500 C.V.)	71 hr.	2 years (Fabricate own pots)	Coke-fired setting. 6 months
4 ft. 6 in. × 3 ft. 6 in. × 3 ft. 6 in. deep. 7 tons	Job galvanizing dustbins, buckets, etc.	450° C.	183 cwt.	44,720 (500 C.V.)	44 hr.	Inspected at 2 years and still in good serviceable condition	Coke-fired 9-12 months
15 ft. × 3 ft. 8 in. × 2 ft. 4½ in. deep 27 tons	Continuous wire galvanizing	455° C.	2,304 cwt of fencing wire	283,000 (500 C.V.)	144 hr.	Replacement on inspection at 3½ years	Coke-fired 9-12 months
14 ft. 4 in. × 6 ft. 10 in. × 5 ft. 2 in. deep. 90 tons	Job galvanizing	450° C.	1,964 cwt.	424,000 (500 C.V.)	88 hr.	2½ years to date	

• *Constructed by The Thermic Equipment and Engineering Co. Ltd., Preston.*

ensure that there is no flame contact with the pot sides.

This burner arrangement provides a slight temperature head at the top of the setting, which gives the following advantages:

(*a*) It counteracts the high rate of heat loss from the pot sides.

(*b*) It avoids high internal pressures when remelting the metal from cold and the pot stresses arising therefrom.

(*c*) It avoids disturbance of the dross settled at the base of the pot by convection currents.

The products of combustion are exhausted after passing under the pot, and although this arrangement is one with which other workers may not agree, it has not proved detrimental in five settings that have been installed in industry to date. The explanation appears to be that the average temperature of the products passing beneath the pot, supplies little more than the heat loss demands through the refractories and does not contribute, other than in this manner, to the heating of the setting.

The withdrawing of the hot waste gases by means of an eductor facilitates their further use and in two installations the waste gases augment the heating arrangements of drying ovens used in connection with the process. Where this is practised the overall efficiency of gas application is of the order of 80 to 90 per cent.

In relation to other designs, pot life with these settings has been considerably extended, whilst initial capital outlay and maintenance and running costs have proved lower. In addition, control of temperature and of combustion efficiency is extremely simple, being achieved by the use of single valve control.

A section illustrating the construction of settings of this type, together with tabulated performance data for several settings, is provided with this paper.

Other Developments

Amongst other methods of heating there are two which I should like to mention. The first, evolved in the United States of America, makes use of a salt-jacketed pot and is most interesting in the promise it offers of improving pot life. Here, the salt in the jacket heated by immersion burners or externally, acts as the heating medium for the pot. Heating is confined to the sides, but the use of a fluid medium ensures that the heat transmission is uniform and definitely eliminates local overheating, one of the most prolific causes of pot failure.

A patented system on similar lines has been developed in this country, by the South Eastern Gas Board, the chief difference being in the use of lead as the heat transmission medium. In the installations made in industry, immersion tubes are used for heating the lead jacket, and it is claimed that the temperature head in the lead is only 15° C. in excess of the operating temperature. Whilst the construction of a pot with integral heating jacket involves a higher capital outlay, it would appear that the system offers ideal conditions for obtaining maximum pot life, and the practical results over a period of years will be watched with interest.

Design Factors and Operating Conditions

In concluding this short paper I should like to summarise the desirable design factors and operating conditions, in galvanizing plant as follows:

1. Local overheating must be avoided, i.e. the temperature distribution on the pot sides must be as uniform as possible.

2. A slight temperature head should prevail at the top of the pot.

3. The heat transfer rate through the pot sides should not exceed 10,000 B.Th.U. per sq. ft. per hr.

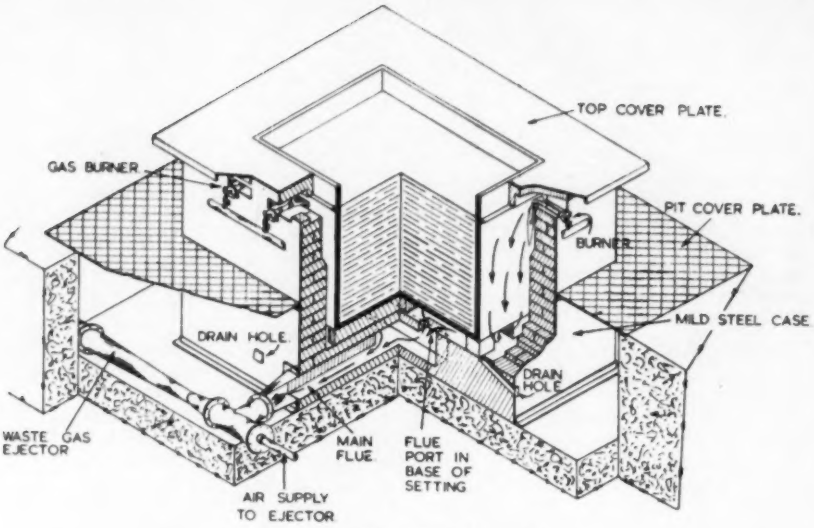
4. The capacity of the pot in relation to the hourly process load must be adequate. An allowance of 20 lb. of zinc to 1 lb. of production is recommended.

5. The pot wall thickness should be adequate, in relation to shape and capacity of the pot.

6. The pot should have ample depth to avoid disturbance of dross by production.

7. Insulated removable covers should be provided on all pots not in continuous use.

8. Provision should be incorporated to deal with metal which might leak



Isometric view of 7 ton setting

from the pot and so avoid blockage of flue-ways in the event of pot failure.

9. The burner system should have an adequate turn-down range to facilitate control under "no-load."

10. Insulating refractories should be used wherever possible.

11. Control of temperature in operation is most important. If automatic temperature control gear is used it should always be of the floating type so that wide swings in temperature on the outside of the pot are avoided.

12. Drossing should be carried out at regular intervals; every seven days is suggested.

13. Pots should be inspected internally at regular intervals—six months is suggested—and repaired or replaced as necessary. It is cheaper to do this than to expend capital and labour on removing frozen metal in the setting generally, after a pot failure.

Short paper presented at the annual meeting of The Institution of Gas Engineers, June, 1950.

Assisted Convection Space Heater

OUR illustration shows a new type of "assisted convection" space heater, of pleasing design, recently introduced by Wm. Sugg and Co. Ltd. It incorporates thermostatic safety and temperature-control devices and is supplied for use with or without a flue.

Design

A gas burner is arranged in a combustion chamber in such a way that the hot products of combustion pass into a bank of vertical tubes, rectangular in section, placed above the chamber. The tops of these tubes enter a top header box from which the flue gases pass backwards and downwards through a draught diverter to the flue or, in another model, forwards through the front into the atmosphere.

A small electric fan draws in air from floor level and blows it up through a vertical passage between the combustion chamber and draught diverter. From the top of this passage, the air passes between the heated tubes and out through

the front to the atmosphere. The high velocity imparted by the fan, coupled with the splitting into thin streams provided by the multiple tubes, gives a high heat-transfer efficiency in what is a very small, compact unit. By its use, temperature differences in a normal living room can be reduced to about 3° F.

Control by Thermometal

A single valve unit mounted in the combustion chamber functions both as a safety, and as a temperature control device. It ensures safety by operating to prevent the escape of gas from the main burner unless the pilot jet is alight. When a failure of the electric supply to the fan, or other breakdown, causes overheating, the valve unit operates to cut off the main gas supply before any damage is done. It can be readily restored by re-setting as soon as the cause of failure has been located and corrected.

Because of its high temperature-deflection rate combined with stiffness, and because it is most sensitive in the 50°—300°F. range, Highflex 45 Thermometal is used for the vital "detector" parts of the valve unit.

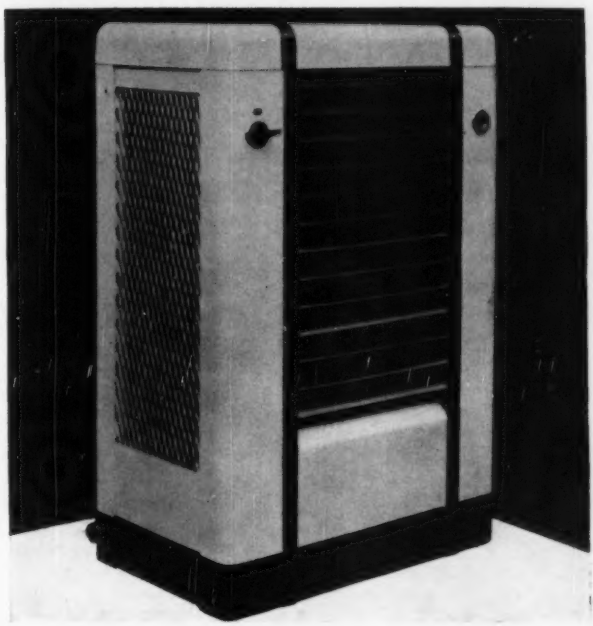
The fan is also controlled by a device incorporating Highflex 45, which automatically operates to start the fan running about three minutes after the gas burner has been lit, conversely the fan will be kept running for a few minutes after switching off the gas, when the resultant drop in temperature causes the thermometal to operate a cut-off switch. This device prevents the emission of cold air when the heater is switched on and, on the other hand ensures that stored heat will not cause overheating when the gas supply is shut off.

Simple Operation

The thermostatic devices reduce manual operation to the control of a single off-on knob, which may be used to turn the heater up and down, exactly like an ordinary gas fire cock. It is possible, however, by fitting a by-pass jet operated by a room thermostat or a clock, or both, to arrange the heater to switch on and off automatically.

LANCASHIRE DYNAMO & CRYPTO LTD.

WE have received an interesting booklet from Lancashire Dynamo and Crypto Ltd., Trafford Park, Manchester 17, in which illustrations and details are given of their motors for use as power station accessories; their flameproof motors for mines, oil refineries, chemical works, gasworks, etc.; their motors and generating plant as used in gasworks; and their alternators as used in the manufacture of sugar.



The new type "assisted convection" space heater, introduced by Wm. Sugg and Co. Ltd.

The stand of F. J. Ballard and Co. Ltd., showing a convection conveyor enamelling oven

INDUSTRIAL FINISHES EXHIBITION

Gas Plays Its Part

THIS first Industrial Finishes Exhibition ever held in Britain was opened on 30th August, 1950, by Sir Charles Goodeve, F.R.S., Director of the British Iron and Steel Research Association. In his opening remarks he said:

"We are present here this morning at the opening of the first Industrial Finishes Exhibition, and we have had the privilege, ahead of the public, of seeing this splendid effort. This Exhibition has come at an opportune time. British manufacturers, in the first few years after the war, suffered from many frustrations, shortages of supplies, especially of good quality materials, shortage of skilled manpower, lack of modern equipment and a pressure of demand that left no time for development work. As a consequence, quality, and in particular when related to the finish, sometimes suffered. That common expression, 'war-time finish,' persisted.

Tremendous Improvement

"Happily there has been a tremendous improvement in the last few years, a fact to which this Exhibition gives strong testimony. Today we have in this country the techniques, materials and skills required for industrial finishes, second to none in the world. Credit in bringing this about is due to a group of industries which have now come together to show manufacturers and users what can be done. A failure in any particular line of goods to stand up to requirements

can today only be attributed to lack of knowledge of the various techniques available, either on the part of the manufacturer and his staff or on the part of the user when he states what he wants or discriminates between alternatives. This Exhibition will go a long way to spread the knowledge of what can be done.

"Metals being the major material for the manufacture of consumer goods, it is perhaps natural that their surface finish should play a dominant part in this first exhibition. Nevertheless, the problems of industrial finishes occur over a wide range of materials, and much that is to be seen at this Exhibition has application in other fields. This first Exhibition has been kept down to modest proportions, but it has been found possible to include prominent members of most of the groups of the finishing industries. Manufacturers and users will see the ever-growing range of alternatives of finish, of processing or of application plant which they can apply to their own specific problems. They will also get some glimpse of the research and development being carried on behind the scenes which is producing better, cheaper and more appropriate finishes every year."

Quality Finishes

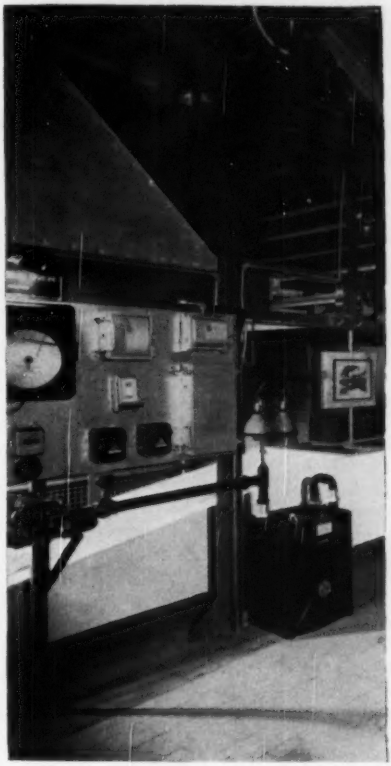
Obviously, the importance of the finishing industries to any country are immense. The last job by the manufacturer, but the first appearance to the customer, crystallises the importance of finish as a sales media. Dress up the goods in fine array, and the inferior in performance might take pride of place with the superior. British prestige has always depended upon quality of manufacture, and thus quality finishes are very much to the fore.

It is no good suggesting that the finishes of British goods twenty or thirty and even fifty years ago were poor. Relatively they were in the superlative grade by comparison with other countries. Yet they were the work largely of craftsmen. The coach finisher of olden days had his prized possession of badger brushes, which cost him personally a lot of money in relation to his wages. One coating after another of his carefully selected varnishes was laid on, until the job would literally last a lifetime, as is witnessed by the preservation of old stage coaches as today's museum pieces.

However, in the march of civilisation, goods were produced in ever-increasing quantities, and as a result their price fell and brought them within the income range of an increasing number of people. Who would have thought of a worker in a factory of fifty years ago owning a motor-car? Yet the car park is an essential ancillary of every large factory today.

Finish Often Skimped

Step by step mass-production increased, and the problems were to achieve as near the quality of the old at the cheaper price of the new. Unfortunately in Britain this transition was applied first in the machine shops, press shops, tool rooms and so on, and



A close-up of the gas meter and controls of the Ballard oven

there was a tendency to consider the finish as something which had to be put on when the article was made. It was not given that careful attention in costing initially, so that the finish was often skimped to get into the production cost margin.

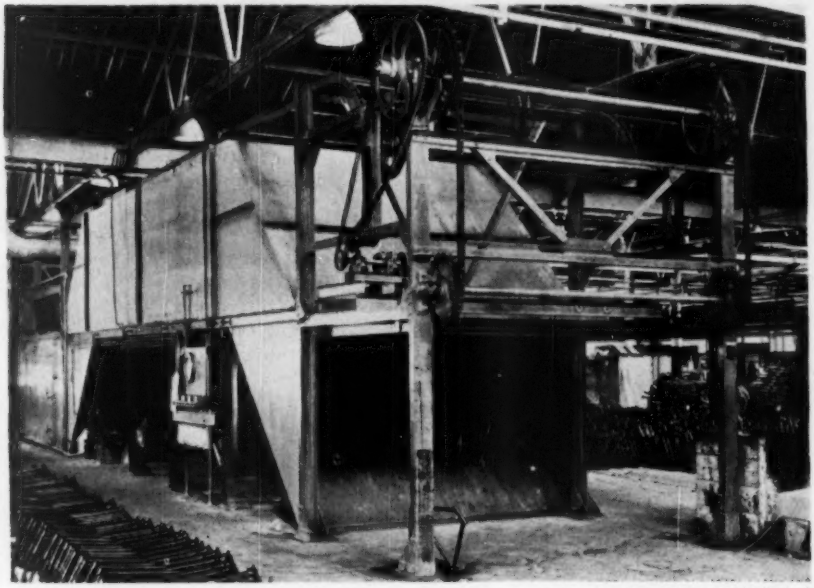
By bitter experience it was discovered that no matter how careful had been the designer, toolmaker, and no matter how carefully the production engineer had laid out his milling machines, capstan lathes, automatics, and so on—the metals he used, with few exceptions, needed a protective coating to protect them from the climate and atmosphere in which they found themselves. The beautifully finished machine tool was as good in service as its finish, and a faulty finish cut short its life.

The lesson has been learnt!

Most Convenient Fuel

It might be asked what all this has to do with gas? The main point is that gas is still one of the most convenient and economic forms of conveyorised fuel yet available in the British Isles. Many finishing problems are indeed gas problems.

Starting in the manufacture of paint itself, the modern varnished metal finds gas heating to be as good as any form of heat supply. In electroplating, gas is the medium whereby the plating baths are maintained at the critical temperature so important for the best results. It has been realised that clean surfaces are essential to give best results with any applied finish. Thus, phosphating tanks and tanks for pickling, etching and alkali cleaning are invariably gas heated. In turn, these have thrown up problems of economic usage, and the various Industrial Gas Development Centres in Britain have developed experts in the finishing field who appreciate finishing problems. They have paid attention to burners and their location. They have paid more attention to the insulation of the tank, so that the heat cleaning tank no longer provides a source of heat for the factory.

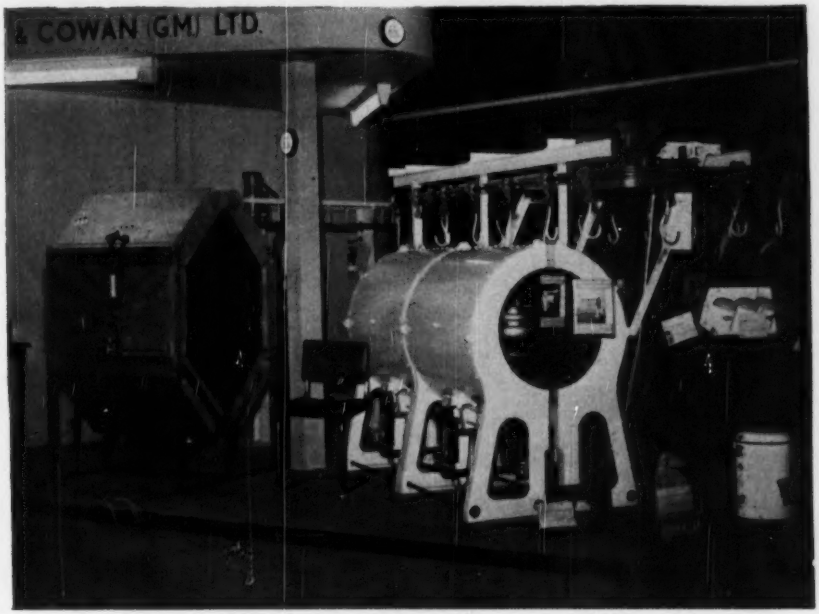


Courtesy, A. E. Griffiths Ltd.

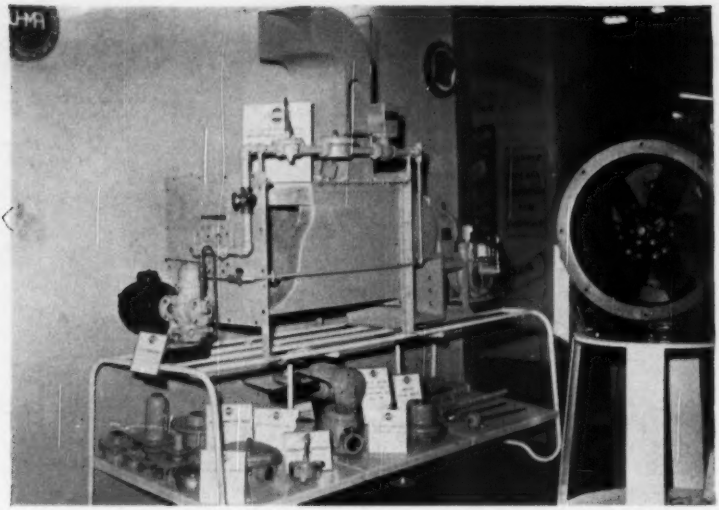
The unloading end of a large standard type conveyor oven

Moving on from there, the paint manufacturer developed the well-known alykyd resins, which became the basis of the modern stoving finishes. A recent innovation has been the styrene finishes. These are cured in a manner different from the older drying oil, or linseed oil, type of finishes. The latter needed oxygen

A Potterton infra-red oven unit was shown on the stand of Thomas de la Rue and Co. Ltd. (Potterton Gas Division)



On the Parkinson and Cowan Ltd. stand was shown a model of two 2 ft. diameter infra-red tunnel units for stoving paint, and many other processes

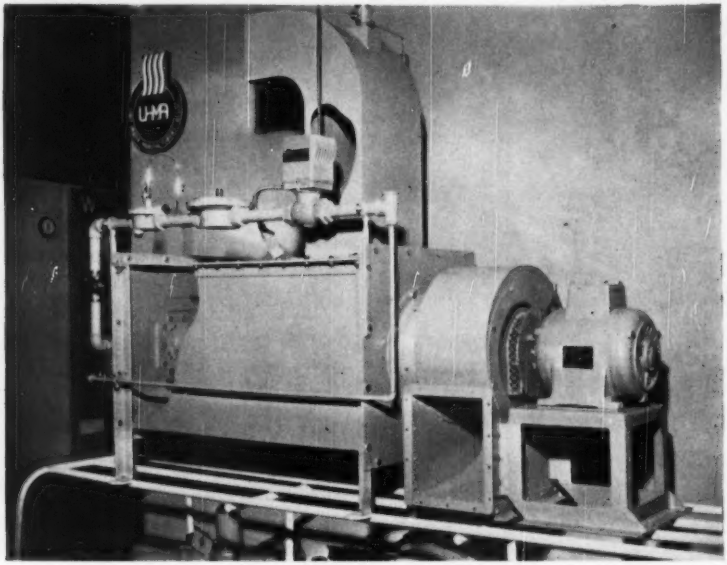


An exhibit on the stand of Keith Blackman, showing gas-fired air heating apparatus

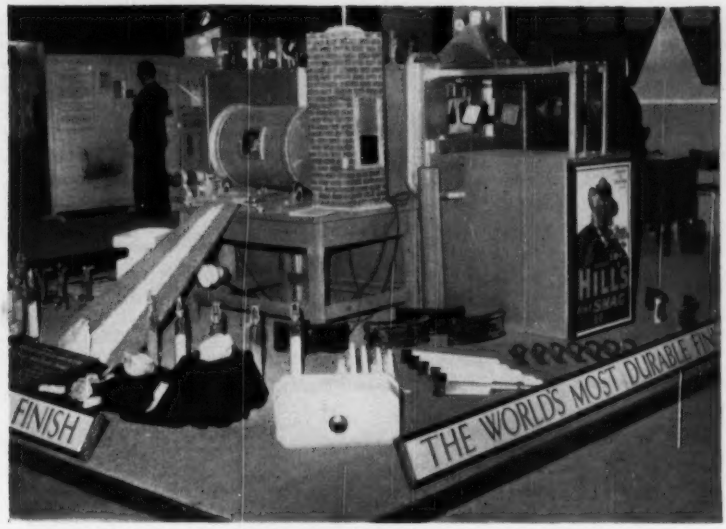
from the air to cause hardening. The former harden by internal condensation or polymerisation, and were independent of an oxygen supply from outside sources to but a limited extent. The well-known name "synthetic stoving finishes," became more and more important, till now practically every motor-car, refrigerator and most sheet metal goods are finished by synthetic stoving finishes.

Time and Temperature

The hardening of these new paint films depended almost entirely upon two factors—time and temperature.



Another view of the Keith Blackman air heating apparatus used for high temperature drying



A general view of the Vitreous Enamelling Association's stand at the Industrial Finishes Exhibition

First it was the box oven with a row of gas jets underneath, not unlike a large gas cooker. Then it was found that the products of combustion affected the surface of the paint film, so indirect firing gas ovens for stoving came along. Over in America, Glover of the Ford Company, hit upon the idea of using an electric element with a gold-plated reflector for touching up stoved parts. Thus "infra-red" stoving was born just before World War II.

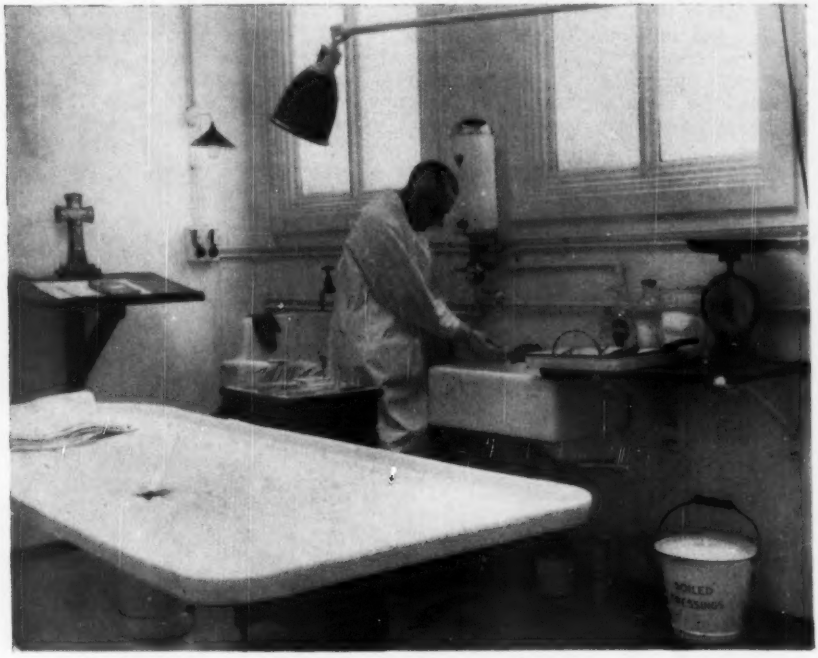
A feature of the Vitreous Enamelling Association's stand was this model of a continuous porcelain enamelling furnace

Allowing for the initial ballyhoo—which unfortunately still prevails—surrounding the name "infra-red," it was a distinct contribution, for in many cases it enabled the stoving cycle to be cut considerably. The gas industry did not lag behind long. The various Gas Development Centres, particularly those in London and Birmingham, developed the popular gas-heated radiant heat, or infra-red, tunnel ovens built up in sections or from separate panels. At a time when the electrical peak load in Britain was a hindrance to production, gas-heated infra-red ovens gradually caught up with their electrical rivals.

As would be expected, the convection oven designers did not lag behind. They looked at the performance of the infra-red, and as a result the popular camel-back forced air convection oven came into being. Here gas as the source of fuel heats a chamber around which air is forced, whence it passes directly into the interior of the oven. From turning on the gas to reaching a working temperature of 280°-300° F. with a camel-back convection oven the time was cut to between three and four minutes, which is shorter than the time necessary to get the other parts of a conveyor line going. By using a bar conveyor, the effective length of the conveyor in terms of articles was increased by comparison with the monorail conveyor.

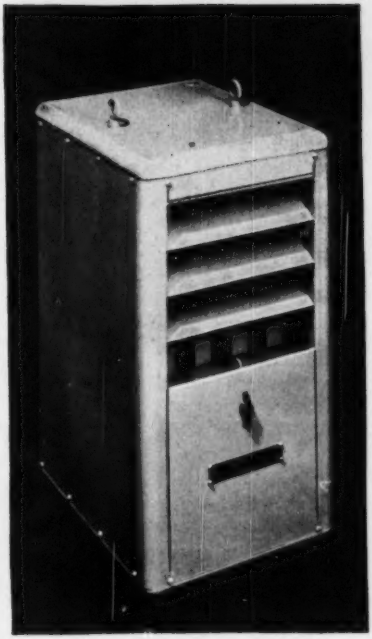
Designers of both radiant heat and convection ovens set out to produce the correct temperature time schedule for the paint film as quickly as possible with the minimum gas consumption.

There is no doubt that in stoving organic coatings, gas has played a tremendously important part.



An Ascot boiling water appliance Type RS52/1 installed in the mortuary at Newport, Mon. It will be readily apparent that this particular appliance is eminently suitable for supplying hot and boiling water in such premises, where, of course, it is desirable that a high state of hygiene exists, and where it is necessary to sterilise instruments, gloves and so on

HARRIS



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Paint and Varnish Making

The Heat Treatment of Oils and Resins

PART 2

WE now come to the gas equipment for non-drying oils. Fig. 1 is a plant for varnish making. On the left hand side is the gum running kettle, and on the right, the furnace for oil heating. The oil, which is to be added to the run gum is heated to a temperature of 325°-350° F. before being added to the gum. The waste gases from the gum kettle are used to preheat the oil, but this heating is supplemented by a small air blast burner shown at the base of the oil heating section.

Fig. 2 is a drawing of the gum kettle. The maximum charge for this kettle is 1 ton, although it is possible to fuse as little as ¼ ton. The approximate time to fuse 1 ton is 4½ to 5 hours. After the gum is fused, oil is added from the oil kettle. This process known as "oiling" usually takes about 3 hours, the actual time depending upon the type of varnish being made and the amount of bodying required.

The gas required for running 1 ton of gum with approximately 2 ton of oil added and bodied was 14,290 c. ft. (71·4 therms). About 1,100 gallons of varnish are obtained when this product is suitably thinned. Fig. 3 shows a plant for making black varnish. Black varnish is usually made by heating and bodying the oils first and then adding pitch or asphalt slowly to the treated oil. When this has been done dryers of various types are added as with clear varnish, and the product is thinned to standard viscosity. The charge for the plant shown in the illustration is 2 ton, and the yield is approximately 1,700 gallons of varnish. The gas used for producing a

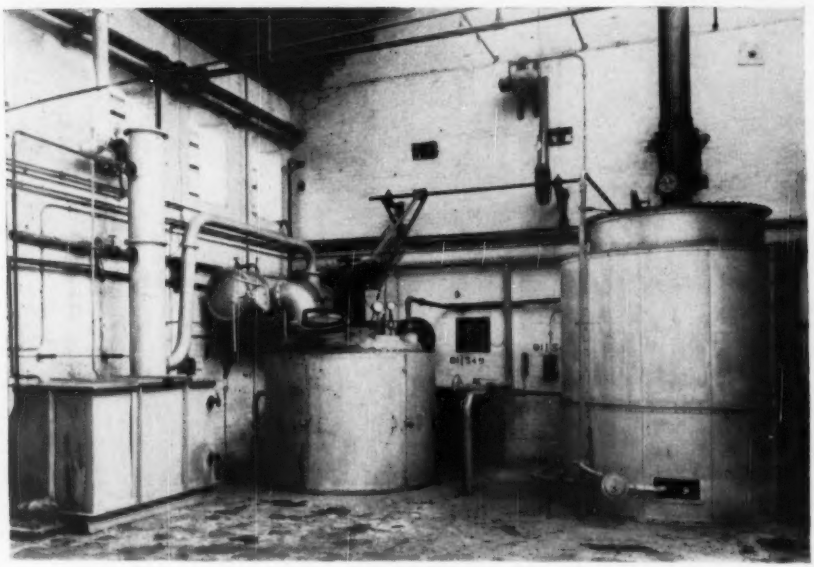
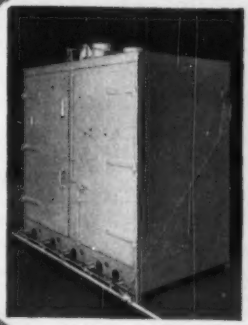


Fig. 1. General view of a gas-fired varnish making plant



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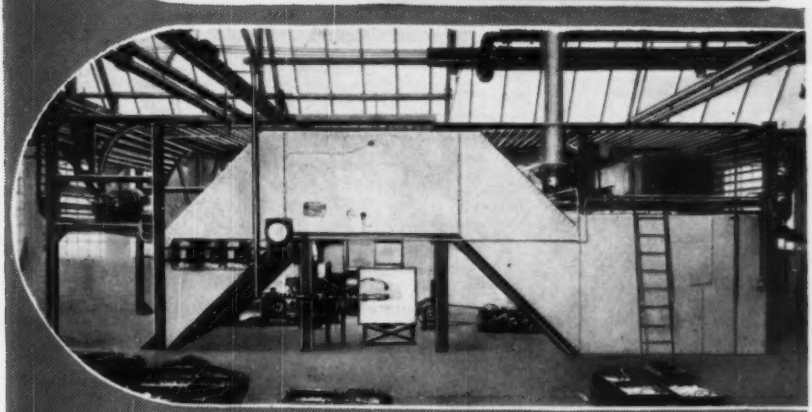

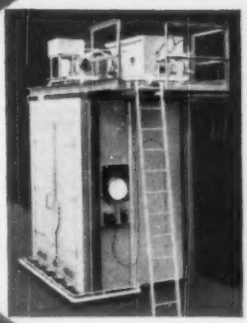

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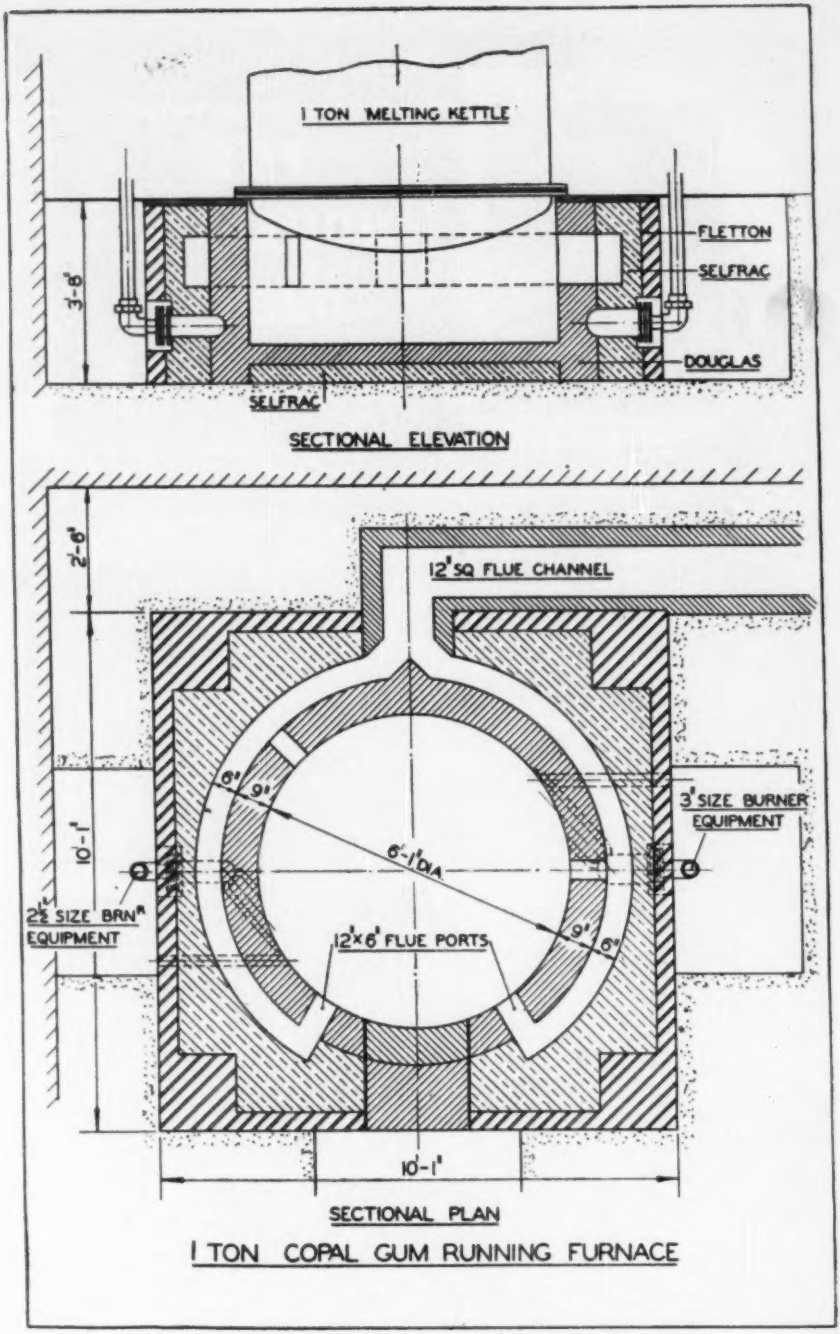

Fig. 2. Sectional drawing of a 1 ton copal gum running furnace

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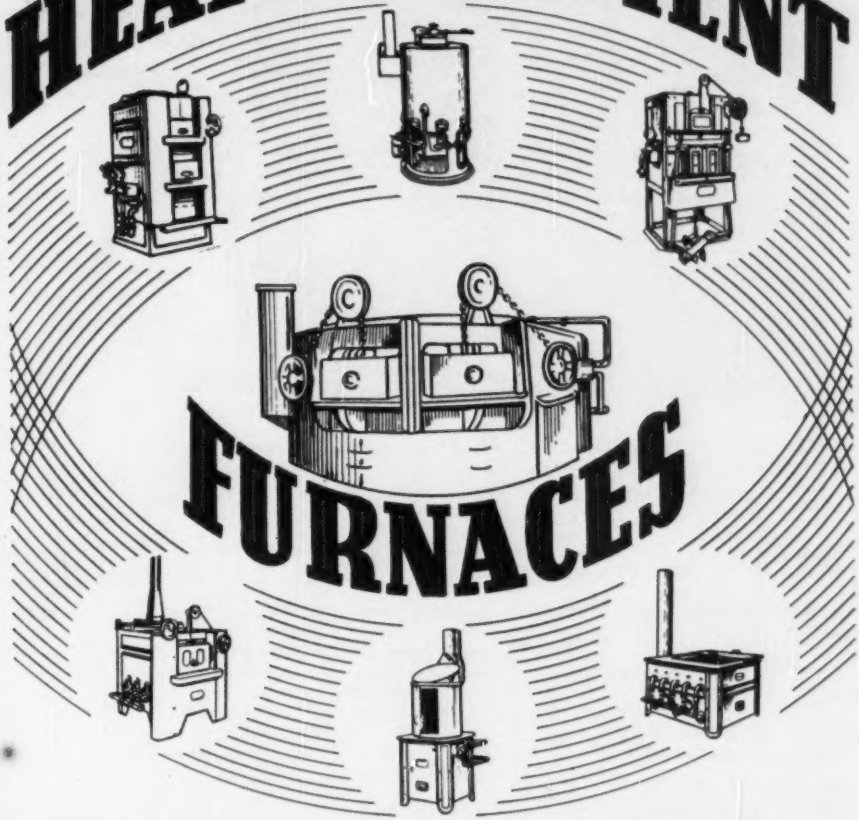

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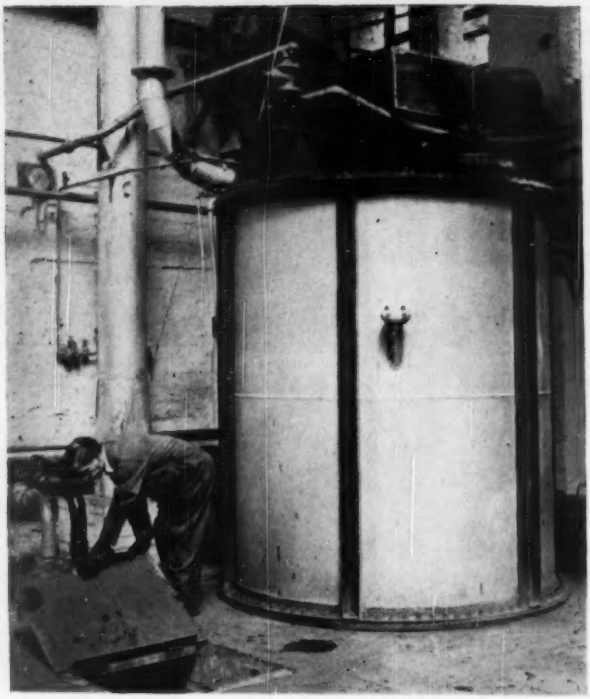

Fig. 3. A 2 ton black varnish making plant, with an approximate yield of 1,700 gallons of varnish

batch of 1,700 gallons is about 16,400 c. ft. (82 therms). It should be mentioned that although the gas consumption for producing varnish in the plant just described is roughly the same as for a similar quantity made

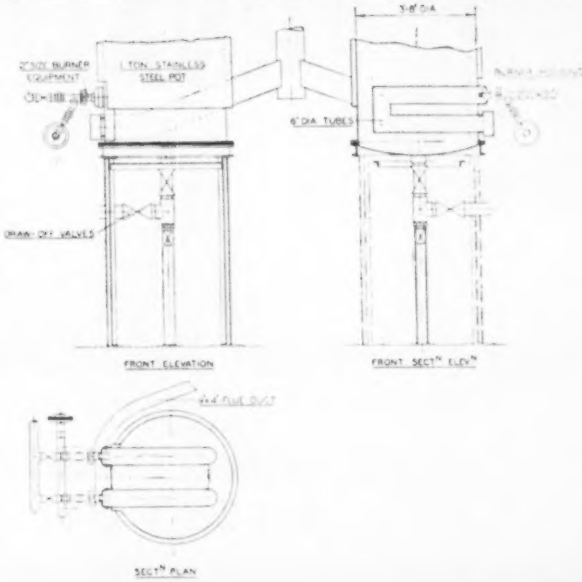

Fig. 4. Drawing of plant designed for heating a charge of 16 cwt. of oil to 570° F. in approximately 1 hour

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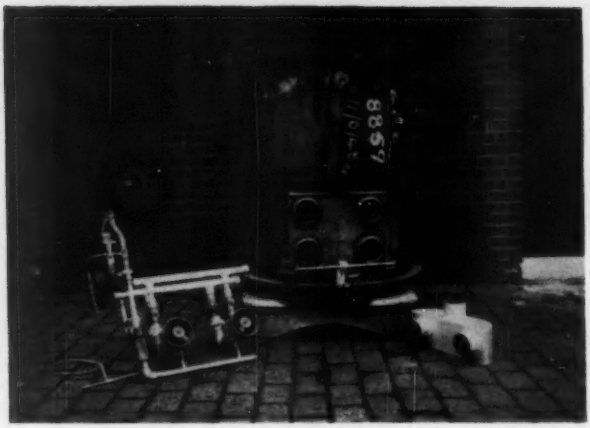

Fig. 5. The pot detailed in Fig 4, shown ready to receive the burners, which can be seen on the left

in a series of small pots the labour costs are only about a third. Moreover, when this plant is used for the production of clear varnish the product is considerably clearer than is the case when small pots are used for treating the same ingredients.

Immersion Heating

The Gas Light and Coke Company (now incorporated in the North Thames Gas Board) was approached by one of its customers for advice on the heating of a charge of 16 cwt. of oil to 570° F. in approximately 1 hr. but it was stipulated that no brickwork was to be used since it is essential to the success of the process that the batch be cooled immediately the required viscosity is obtained. Kestner plant heated by thermostatically controlled electric immersion heaters had been used and good results obtained.

Synthetic materials are used in the particular process and if these are not cooled immediately the required viscosity is obtained, "gelling" results.

It was estimated that a gas rate of approximately 2,500 c. ft. (12·5 therms) per hour would be required with the normal type of brick setting

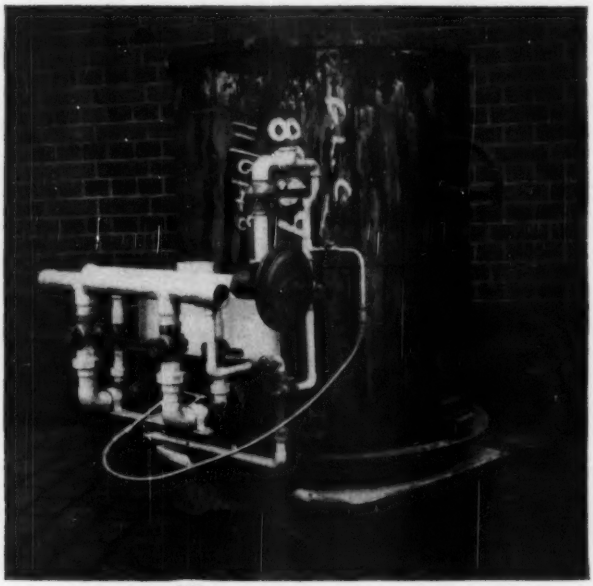

Fig. 6, showing plant with burners assembled in position

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to satisfy the time requirement, and it will be appreciated that a gas rate of this order without some form of heat insulating surround would not be an efficient proposition. A further requirement was that the pot should be mounted at a suitable distance from the floor to enable the finished material to be drained from the pot into drums. It was therefore necessary to design the pots for tubular immersion heating and two pots with completely automatic control including Protectoglo flame failure equipment with spark ignition, have been built.

action at the time two sets of tubes were fitted in order that the firm might gain experience with the system. Fig. 5 shows the pot ready to receive the burners which are seen on the left hand side of the photograph. Fig. 6 shows the plant with the burners assembled in position. The burners were of similar design to those in Fig. 4.

A number of charges of raw linseed oil were treated. The weight of oil treated in each test was 960 lb. The average time to heat each batch to 580° F. was 3 hours, and the gas consumption was 940 c. ft. (4·7 therms).

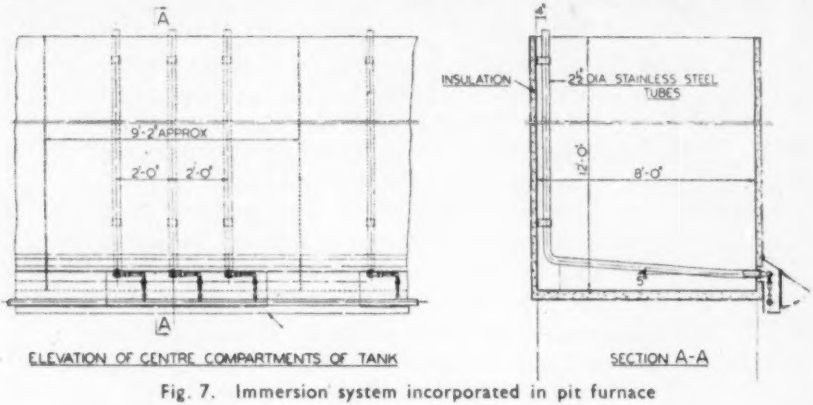

Fig. 7. Immersion system incorporated in pit furnace

Fig. 4 is a drawing of this plant in which the burners fire into the immersion tubes at a high level and the products of combustion are discharged at a lower level into a flue duct. It was necessary in this installation to employ this method of firing which with air blast burners gave satisfactory results, but had low pressure burners been installed it is unlikely that this arrangement would have been successful. British Furnaces high velocity burners were used with low pressure gas and air at 1 p.s.i. The burner heads are of Tungum heat resisting bronze drilled with the requisite number and size of holes to suit the inspirator throat size. In order to obtain quick cooling the pots were made with a 2 in. jacket for water cooling.

Further Example of Immersion Tube Heating

Another firm expressed interest in this method and as a pot was out of

The original furnaces which were of the pit type already described consumed 400 c. ft. (2 therms) of gas per hour, and these took approximately 4 hours for the same operation.

Great Possibilities

It is apparent that the immersion system has great possibilities for certain processes, especially as brick settings can be dispensed with and the pots erected on a suitable staging so that the product can be emptied directly into drums when the charge has been heated. With the old arrangement it was necessary to pump the product from the pots with a portable electric pump. The pots used for the normal type of pit furnace have a bottom dished, 6 in., which is flanged to the pot side in order to permit renewal of the bottom of the pot where necessary, whereas with the immersion system, the design of the pot is simplified, and the heating

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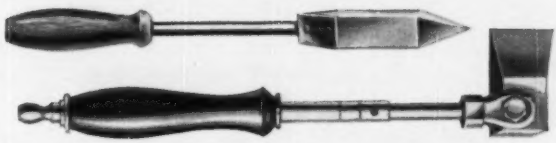

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tubes may be arranged nearer to the bottom of the pot.

The oil when received at the works of the varnish maker is pumped into large storage tanks which are normally erected outside the factory. During cold weather great difficulty is experienced in pumping out the oil. If steam heated coils are used to keep the oil warm, it may be necessary at night to keep in operation a large boiler which would normally be shut off at night. In order to overcome this difficulty consideration is being given to the fixing of immersion tubes to these tanks. The burners would be arranged to give sufficient heat to keep the oil at approximately 40-50° F. Low pressure burners will be utilised and the control will be such as to prevent any possibility of overheating the oil. This proposal is shown in Fig. 7.

Prepared from a report of the Industrial Gas Committee, North Thames Gas Board.

Gas Cooks Schoolboys' Dinners at Darlington

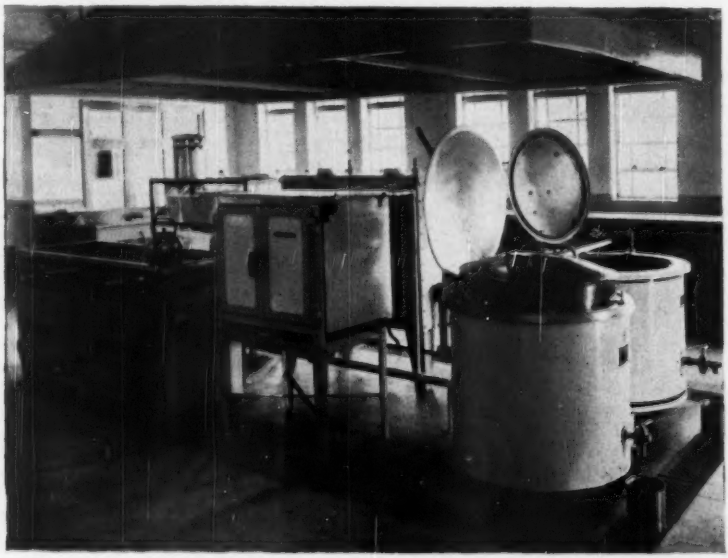
A NEW dining-room, which is served by an all-gas kitchen, has recently been installed at a boys' secondary school in Darlington.

The photographs show the dining-room to accommodate 200 children, which is heated by overhead gas-fired heaters, thermostatically controlled, and a general view of the kitchen, designed to cook and serve 400 dinners in two sittings.

The gas equipment comprises: a double oven cooking range, double compartment pudding steamer, roasting oven, 30 gal. vegetable boiler and steamer and 40 gal. boiler and a 6 ft. hot closet. A mechanical extractor is provided to the canopy fitted over the appliances.

Domestic hot water is provided from a gas-fired boiler with 150 gal. storage cylinder. A duplicate dining-room and kitchen is at present being erected to serve the Girls' School adjoining.

The installation was carried out by the Darlington Undertaking of the Northern Gas Board, under the supervision of Mr. Charles Hindle, engineer and manager.



General view of the kitchen, designed to cook and serve 400 dinners in two sittings

This school dining-room is heated by overhead gas heaters
General view of the all-gas kitchen

Laundry and Dry Cleaning Exhibition

Olympia, from 28th September—7th October, 1950

THE Gas Council's stand at the Laundry Exhibition will feature the latest gas-fired appliances which are available to laundries and dry cleaning establishments, and special equipment for use in high-class finishing. The value of gas-fired equipment to the laundry industry, where cleanliness is paramount, is apparent and, not only can gas as a fuel provide cleanliness, but also it is reliable and constant and can do the job both quickly and economically.

The "Formette" dry cleaning unit (D. S. Fordyce and Co. Ltd.) gives the highest quality steam-air finishing to all types of garment, and economy is assured by the speed of operation, which averages up to fifty garments per hour. This unit will be shown in conjunction with one of the gas-fired steam boilers of Controlled Flame Boilers Ltd., with automatic control which ensures accuracy of heating, simplicity of operation and economy in running.

The Keith Blackman Ltd. laundry irons, heated by high pressure gas, have been found both economical in use and simple to operate. The air supply is adjusted and fixed by the engineer in charge of the laundry, leaving to the operator a simple control which supplies maximum heat, moderate heat or shuts off the gas. Also on view will be a suitable type of rotary compressor (also Keith Blackman Ltd.) for compressing gas with these irons.

Other exhibits on the stand will include one of the latest gas-fired drying cabinets, water heaters and storage heaters.

Change of Address.—As from 14th September the address of the South-Western Region of the Ministry of Fuel and Power has been changed to Flowers Hill, Brislington, Bristol 4 (telephone number: Bristol 75341). All sections have been moved to this address.

SOME NOTES ON BURNERS

by

G. E. THOMAS, M.Inst. Gas E.

Divisional Industrial Gas Engineer, Watford Division, Eastern Gas Board

Aerated Burners

THIS type of burner takes advantage of the mechanical energy of an issuing gas stream to induce atmospheric air into mixing tube prior to its ignition. The flame characteristics are entirely different from those of the non-aerated burner in that the flame has no luminosity, is shorter, sharper, and has higher flame temperature. Furthermore, the flame can be applied to processes calling for direct contact with cold surfaces, there being no danger of carbon deposit on the surfaces.

The principle of design takes advantage of the partial vacuum created by a jet issuing from an orifice and, as a means of promoting efficient mixing, the venturi throat and expansion tube is incorporated as an essential to efficient burner design. Provided conditions of design are complied with, the burner should be silent, capable of considerable turn down range without danger of back firing and, at the same time, achieve relatively high primary aeration. It is possible to induce as primary air approximately $2\frac{1}{2}$ times the gas volume.

Combustion takes place in two stages, partial combustion being completed within the confines of the inner cone from primary air induced and complete combustion effected in the outer flame by diffusion with surrounding or secondary air.

Design of the burner comes in for a great deal of abuse, through:

1. Bad proportionment of injector orifice to mixing tube dimension,
2. Omission of the venturi throat principle of mixing,
3. Incorrect design of air shutter and
4. Eccentric position of injector orifice.

The advantages of this type of burner over the non-aerated burner are; smaller flame with higher flame temperature, capable of supporting combustion in confined spaces.

Fig. 1, illustrates the principle of design of a good and bad injector,

VENTURI TUBE

BAD DESIGN SINGLE STAGE INDUCTION

GOOD DESIGN SINGLE STAGE INDUCTION

Fig. 1

with cross section of injector incorporating the best principles.

Low Pressure Burners of Low Aeration: Duoflam

Cases occur where applications demand flame contact of not exceptionally high flame temperatures but which need reasonable flame stability without the danger of combustion being incompleted by carbon deposit. These conditions can be met very satisfactorily by the use of the Duoflam jet, which is designed for low aeration — approximately $1\frac{1}{2}$ air volumes as primary induction—burners

From a paper to the Eastern Area (Watford Section) Gas Salesmen's Circle.

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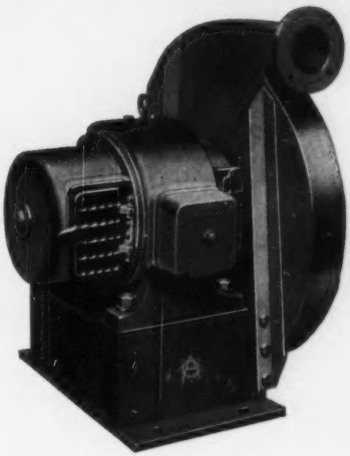

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being arranged so that the flames from each pair of jets impinge, combustion being completed by diffusion with the atmosphere surrounding the flame structure.

The characteristics of the flame are: absence of inner cone, greater flame length and lower flame temperature. Controlability is very good with great range of turn down and little tendency for lighting back.

Fig. 2 illustrates general arrangement of application.

Low Pressure Burners of High Aeration

Of recent years, an important development on increased primary aeration of burners operating under low pressure conditions has taken

DUOFLAM BURNER (LOW AERATION)
Fig. 2

place, necessitated by the demand for burning large quantities of gas in confined spaces without resorting to the use of high pressure or air blast burners. The main principles of injector design may be seen in Fig. 3.

Air is induced at two stages; the first into a parallel mixing tube so as to retain the velocity characteristic of the mixture, with secondary induction taking place through an approved venturi throat. The degree of primary aeration is in the neighbourhood of 3½ volumes of air to one of gas.

Flame characteristics show consequent shorter structure than normal low pressure single stage aerated burner, but with a higher flame temperature, and the burner is more capable of supporting combustion in confined spaces by virtue of a corresponding reduction in the quantity of secondary air needed for completing combustion.

It is difficult to cause lighting back and, under certain conditions, the burners are per-ignitable, in that ignition can be introduced at the injector, the velocity of the mixture causing the igniting flame to travel with the stream to the burner ports and establish itself at the point of combustion.

High Pressure Burners

These burners are designed to meet the need for liberating greater quantities of heat in very confined space than any of the foregoing burners, complete aeration for promoting and sustaining combustion being induced primarily through the injector. Such burners are designed to operate with injectors similar to those used for low pressure atmospheric burners, but proportioned to suit considerably higher gas velocities. Pressures in the neighbourhood of 3 lb. per sq. in. equivalent to 83 in. w.g. are employed to promote a velocity high enough to induce the full quantity of primary air.

Flame characteristics are: intensely sharp, very small and flame temperature is probably the highest which can be attained on any free burning appliance, or without recuperation, temperature being slightly in excess of 1,900° C. Because of high mixture velocity, the burner is not very sensi-

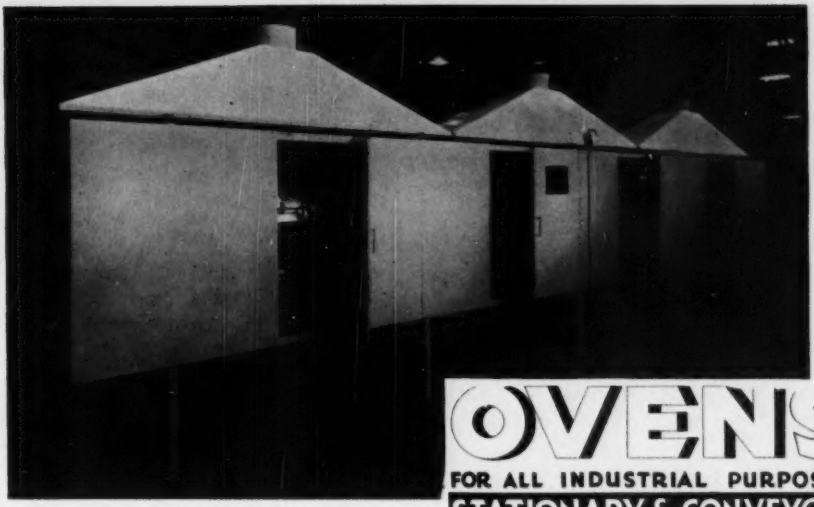
AEROMATIC TWO STAGE INJECTOR (HIGH AERATION)
Fig. 3

tive in its control and, as a consequence, has narrow limits of stability.

Air Blast Burners

The necessity and function of this type of burner is similar to that of a high pressure burner, but, in this instance, the prime mover now becomes air; that is, the process is reversed. Air at pressures from ¼-1 lb. per sq. in. i.e. 14-28 in. w.g. causes gas to be induced through an inspirator, again designed on the venturi principle, so as to provide a complete aerated mixture at the burner.

The flame characteristics are similar to those of the high pressure burner but, possessing greater stability under control, are capable of being sustained



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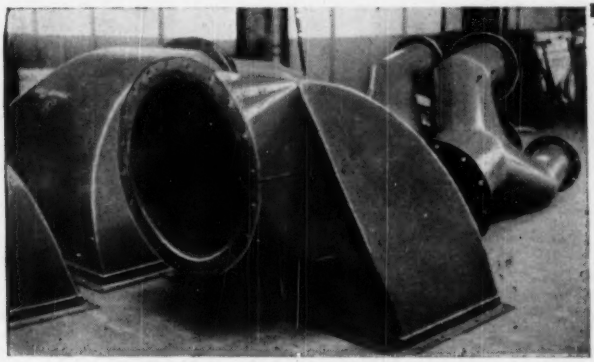

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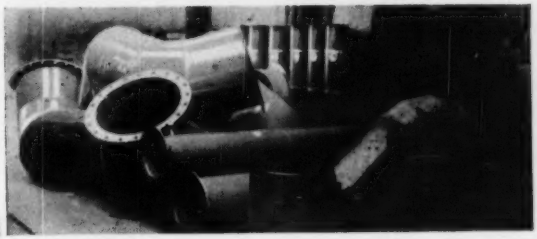

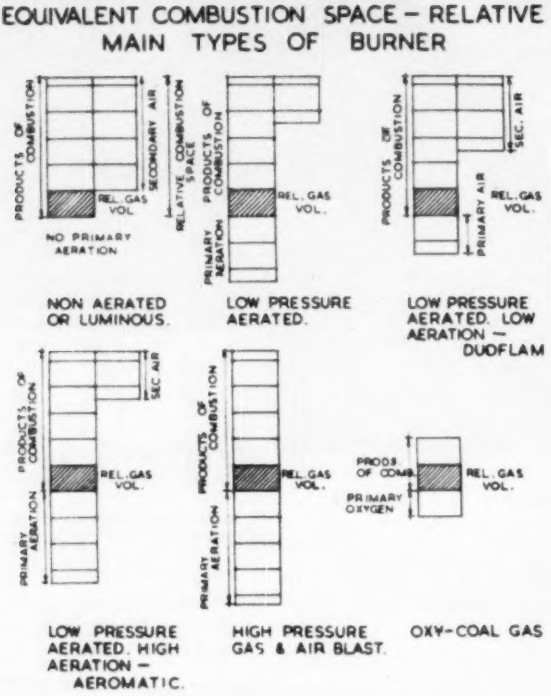

Fig. 4

over considerable turn down range.

Whilst eliminating the need of costly compressing plant, this method of combustion necessitates the running of two pipe lines, air and gas, up to the point of combustion. Proportionment of the mixture is very often cumbersome and difficult, requiring operation of two controls at every stage of adjustment.

Automatic Proportioning Devices

Where control requirements are delicate and it is necessary to maintain proportionment of the air-gas ratios, there are available various types of automatic proportioning devices which respond sensitively over wide limits, merely by operating the air control. These devices are so designed as to reduce gas to atmospheric pressure so that it exerts no motive power of its own accord, but is induced by, and in proportion to, the air velocity.

Oxy-Coal Gas Burners

Reference has been made to the high quantity of inert nitrogen incorporated in combustion mixture where air was used, causing consequent reduction in flame temperature.

Applications calling for high temperatures, involved in welding and cutting, necessitate the use of oxygen alone to obtain this temperature. Using oxy-gas burners, temperatures in the neighbourhood of 2,750° C. can be reached and, as a consequence, relatively high cutting speeds for profiling and other processes are obtainable. Under such conditions considerable thicknesses of steel can be cut cleanly and evenly.

The Northern Gas Consultative Council has protested against the Purchase-tax of 66⅔ per cent. on gas water heaters. A letter has been received from the Board of Trade that when the Chancellor of the Exchequer was reviewing the Purchase-tax the tax on heaters would be considered.

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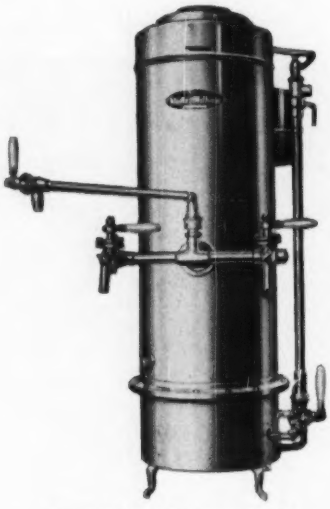
A FEW weeks ago an approach was made to Radiant Heating Ltd., by Polygram Foundries Ltd., requesting a design of furnace capable of heating metal patterns prior to their investment with a coating of plastic powder. The same furnace was then required further to cure the powder after investment. The job had already been tackled successfully with a hot-air oven but the foundry wanted to boost their output without increasing the amount of floor space taken up by the oven. It was considered that high-intensity radiation would speed the curing process, and experiments proved this to be the case.

Temperatures in the region of 280° to 300° C. were required and the furnace was designed to operate at a surface temperature of 700° to 750° C. For obvious reasons it is not possible to give details of the actual process involved but it can be revealed that the plastic, when finally cured, forms a mould into which molten iron or steel may be poured. The quality of casting produced by this method is exceptionally high and can be dimensioned to within ·002 and ·004 in. The following table will show some of the advantages of the change.

	Hot Air	*Radiation*
Heating-up period for oven or furnace	120 min.	15 min.
Platten pre-heat	6-7 min.	2-3 min.
Curing time	2-3 min.	½-1 min.
Maximum gas rate	500 c.f.h.	320 c.f.h.

There should be similar applications worthy of investigation.



Stotts "Magna" water boiler

GAS BREWS 50,000 CUPS OF TEA IN AN AFTERNOON

THE recent centenary celebrations held in Widnes by Imperial Chemical Industries Ltd. involved an outdoor catering problem of considerable magnitude.

The combined thirst of 15,000 guests on a hot June afternoon involves a forecast of tea, not by the teapot, but by the ton, and the Widnes Undertaking, North-Western Gas Board, made plans accordingly.

"Stotts of Oldham" loaned ten "Magna" water boilers for the occasion, and these were connected to the mains by 660 yards of 4 in. and 1 in. gas pipe.

About 50,000 cups of tea were served, and the caterers report that never at any time did the supply of boiling water lag behind the enormous demand.

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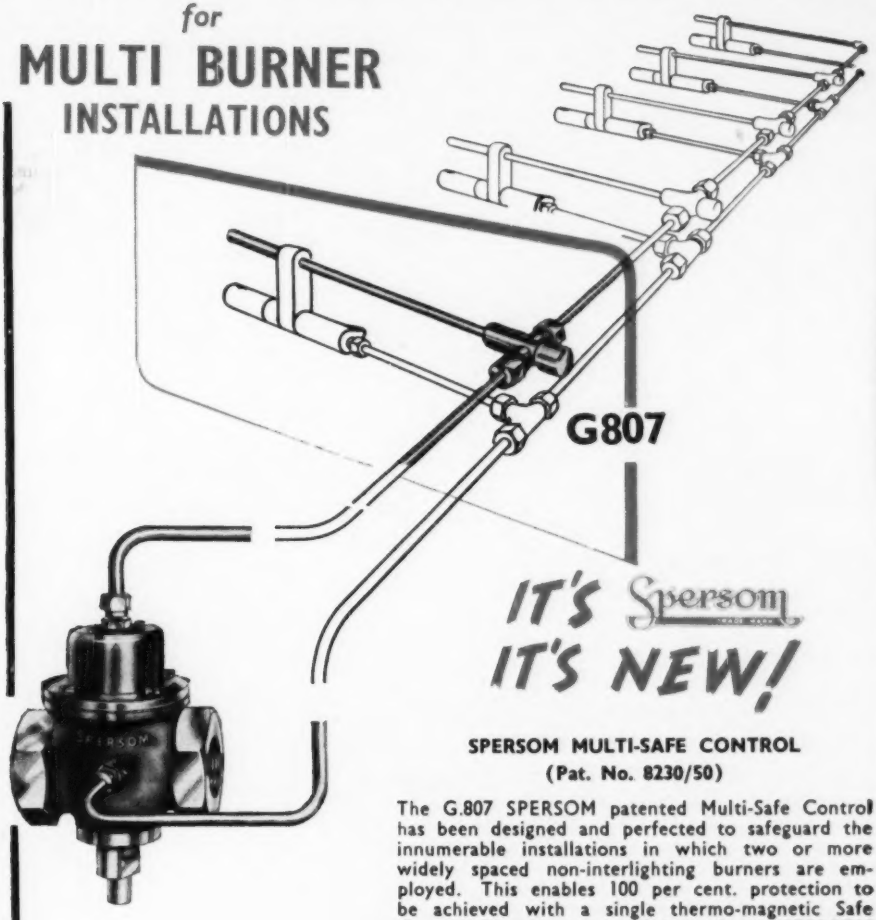

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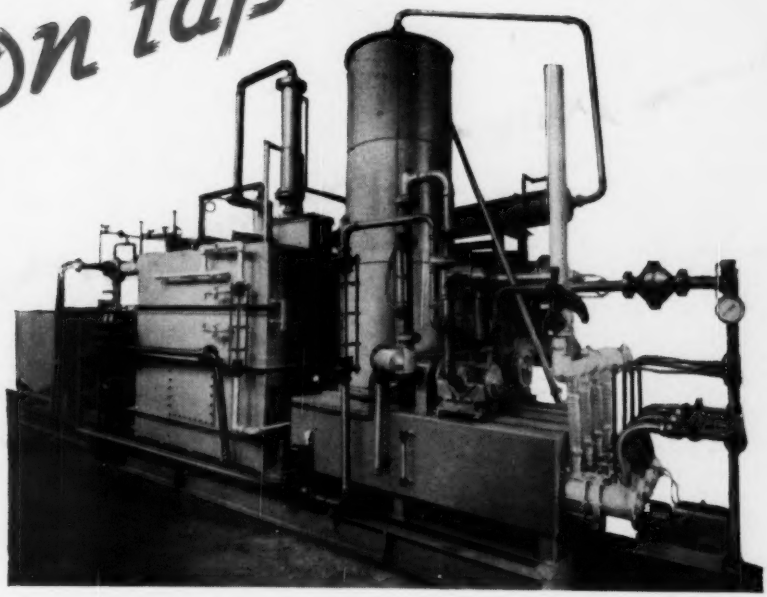

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